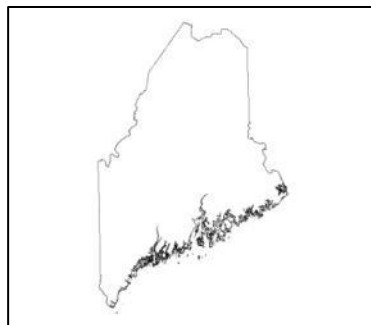


Geologic Site of the Month
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Maine Springs



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Introduction

Springs have been important to civilizations throughout history. In many parts of the world, they were (and are) the only safe and reliable source of water. References to springs and their formation can be found in the Bible, as well as in the writings of Plato, Pliny, Kepler, and Descartes, among others (Todd, 1959). Spring water continues to have a fascination and a cachet that make it valuable in today's retail market. But what is a spring? Why and where do they form?



Photo from Maine Geological Survey



Springs

A spring is defined as a concentrated discharge of ground water to the surface. Ground water flows through aquifers (literally, water-bearers) from recharge areas, on uplands, where it is replenished by rainfall and snow melt to discharge areas, in valleys, where it flows to the surface into streams and rivers, providing them with dry-weather flow (Figure 1). When the flow paths are focused by either topographic or geologic factors, ground water will flow to the surface.

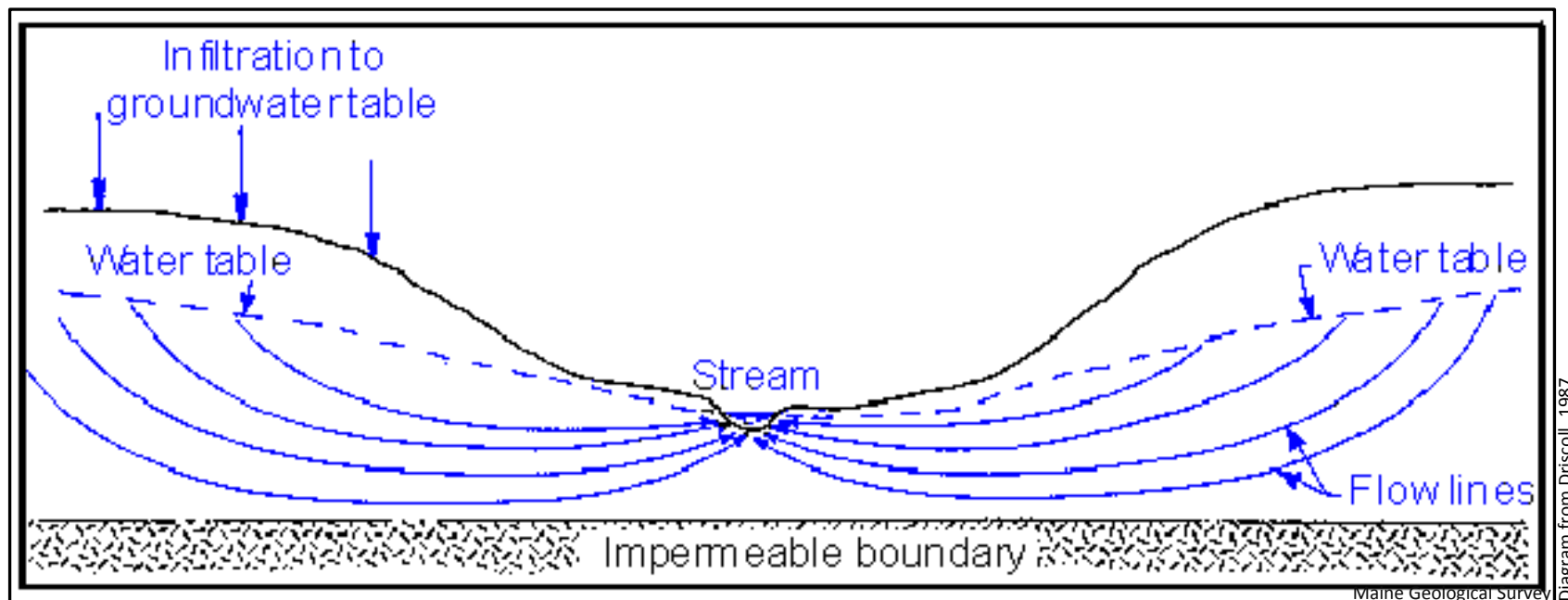


Figure 1. Diagram of spring formation.

Springs in Maine

Most springs in Maine can be generally classified as gravity springs. The water flowing from the recharge area has energy derived from the higher elevation of that area. This gravitational energy forces the water to move through the sand or rock of the aquifer. Most of the time, the energy is pretty much used up by the time the ground water discharges to a stream. If, however, something changes the flow path, the ground water can discharge with some force (Figure 2).

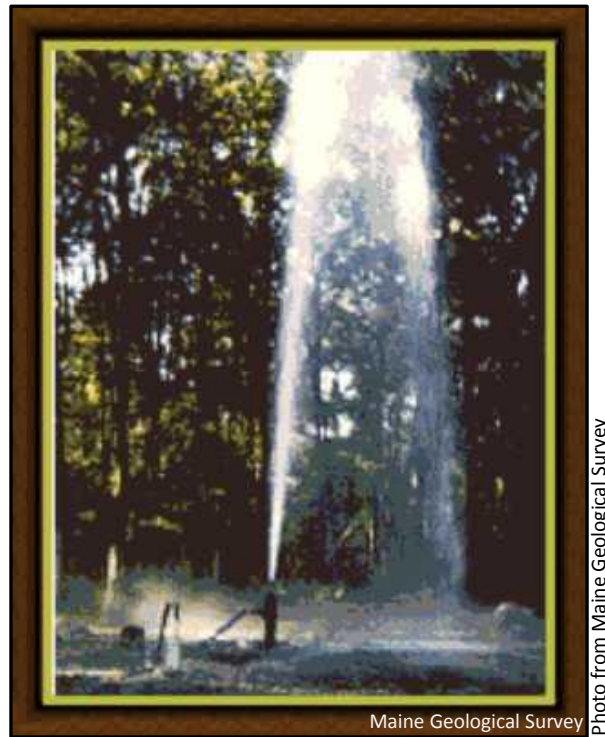


Photo from Maine Geological Survey

Maine Geological Survey

Figure 2. This artesian well is an example of a man-made alteration of the flow path.

Springs in Maine

Most springs are less spectacular than this. They often form where the slope of the land is steeper than the slope of the ground water surface (the water table), so that the ground water reaches the surface and flows out. A spring develops when the flow of this discharging water erodes the surface soil, forming a gully or rill, thus creating a low spot where more water can discharge. Such springs often form the headwaters of small streams, and are common around the edges of sand plains in southern Maine. The spring may continue to grow as the gully deepens and lengthens back into the slope, capturing more water (Figure 3).



Maine Geological Survey

Photo from Maine Geological Survey

Figure 3. Photo of the Kennebunk Sand Plains where ground-water sapping has resulted in a large gully with a spring.

Springs in Maine

Many small hillslope springs have been developed near roads in Maine. Often, a pipe is driven into the hill to help concentrate the discharge so that passers by can use the spring. The [Maine Drinking Water Program](#) has an interesting web page discussing these springs. In some cases, the road itself may focus ground water discharge. Road cuts are good opportunities to observe man-made springs. These springs also demonstrate that ground water flows through the fractures in bedrock (Figure 4).



Photo from USGS

Figure 4. Photo showing the concentration of discharge from fractures in the bedrock on a road cut.

Historical Spring Usage

Water can also find its way to the surface through natural bedrock fractures, or through a sand layer sandwiched between clay layers. These more permeable collectors, again, serve to focus the flow of ground water so that it flows from a small area instead of seeping from the entire hillside. The original Poland Spring was described in 1909: "The water issues from cracks in a dike of porphyry which is about 10 feet wide at the spring and strikes about N 80 degrees W, as nearly as can be estimated" (Clapp and Bayley, 1909).

There were many developed springs in Maine in the late 1800's and early 1900's. A 1906 U.S. Geological Survey census showed 44 commercial springs in southern Maine. Public water supplies were often from rivers and lakes (108 of 149), but many (29) communities used springs as their source of supply. Only a few springs still supply water to municipal supplies. Commercial springs often bottled water for the local market. Bottles of spring water were hauled by wagon from the spring, where they had been filled, to town, and delivered to customers. Water from some Maine springs, like Poland Spring, was shipped worldwide. While the number of spring water bottlers has dropped, the sophistication of the springs' development, and the technology involved in bottling the water and marketing it, have increased dramatically.



Historical Spring Usage

Springs hold magic for us. The sight of water bubbling from the ground can still inspire myth, even when we understand it as a phenomenon driven by simple physical properties of the aquifer, the topography, rainfall, and gravity. Ground water is invisible on its journey through soil and rock, and its appearance as springs is the only naturally-occurring evidence of its presence. At some places, the ground water that discharges at a spring may have been rainfall a few hundred feet up the slope just weeks before. In other places, the journey through the ground may have taken several years and miles to complete. The longer ground water travels, the more minerals it dissolves from the aquifer. The type of soil or rock, and its mineral content, also influence the process.



Photo from Maine Geological Survey

Maine Geological Survey

Figure 5. Water welling up through the soil at a spring.



Historical Spring Usage

Mineral springs were often viewed as healing potions. Spas were built in places like Saratoga Springs, New York, and people would journey for miles to "take the waters" for their health. If you look at the links farther down this page, you'll know that mineral water is now a regulated substance, that has to contain certain concentrations of minerals. This does serve to reduce the romance somewhat. Even at the time, most health professionals were skeptical of claims that mineral or other waters would cure various illnesses, although there was general agreement that pure spring water had a "buoyant effect on the general health."



Figure 6. Collecting drinking water from a spring.

Modern Spring Usage

So, a spring represents a short-circuit in the hydrologic cycle. It is a place where ground water becomes surface water. In Maine, most springs have flows of only a few gallons per minute. The demand for spring water in bottles often exceeds the natural discharge from the spring, and the use of a spring to collect water represents an opportunity for surface contaminants to enter the system. To maintain the quality of the water from a spring, and to increase the yield, more sophisticated means of spring water collection have been developed.

The development of a commercial spring often involves the drilling of a borehole near the spring, and the interception of the spring flow by pumping from the borehole. This practice is regulated by both the federal and state governments. The US Food and Drug Administration has an official definition for spring water, which allows the development of a spring using a borehole under certain conditions. First, when the borehole is pumped, there must be a hydrologic effect (usually a change in flow) of the spring. Secondly, the water quality and mineral content of the water from the borehole must be comparable to that of the spring. And, finally, the use of the borehole should not cause the spring to cease flowing.

These restrictions, together with many quality and inspection requirements, are designed to protect the consumer of bottled spring water. A critique of their effectiveness was presented by the [Natural Resources Defense Council](#). For another view of this issue, you can look at the [International Bottled Water Association's home page](#). The State of Maine adopted rules relating to bottled water, bulk water, and water vending machines ([10-144, Chapter 235](#)) in 2001.

Springs are a fascinating hydrogeologic phenomenon. They are also a cultural icon of long standing.



References and Additional Information

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